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QUARTERLY STATUS AND TECHNICAL

PROGRESS REPORT

Title:                          Evaluation of Spatial, Radiometric and
                                Spectral Thematic Mapper Performance
                                for Coastal Studies


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1. Problems

    Only one TM image of our Delaware Bay test site was available
(PO14, RO33, 12/13/82) and due to snow cover it was unsuitable for
marsh vegetation (biomass) studies.  To solve the problem one of
our Chesapeake Bay test sites was activated and an available high-
quality TM image ordered (PO15, RO33, 11/02/82).  Due to the delay
in transmitting additional TM data from Landsat 4, four more scenes
of similar test sites were ordered (PO14, RO32, 11/27/82 and PO12,
RO31, 9/10/82).  Pictures and tapes for all scenes have been received.

2. Accomplishments

    The majority of our most recent efforts have been to modify
our computer software (a version of the Pennsylvania State ORSER
package) to read and analyze CCT-AT and CCT-PT formatted data. This
task is nearing completion and we will have an operational version
of the software within two weeks.

    An area along the southeastern shore of Chesapeake Bay was
subsetted from the November 11, 1982 TM image.  This area, known
locally as Vaucluse Shores and situated at approximately $37^{\circ}25'$N
latitude, $75^{\circ}59'$W longitude, has historically supported a large
community of SAV.  Wetzel (1982) reported a stable seagrass bed
approximately 140 hectares in size and dominated by Zolstera marina
and Ruppia martima.  The subsetted TM image was enhanced and classified
using an ERDAS 400 system.  The results were compared
with a chart published by Wetzel indicating the distribution of
both Zolstera and Ruppia.

    We have continued to refine our radiative transfer models
describing the irradiance reflectance of a water column containing
SAV.  These efforts will continue until the spring when we can
conduct field measurements to verify our models.

    Radiative transfer theory was used to model upwelling radiance
for an orbiting sensor viewing an estuarine environment.  The
environment was composed of a clear maritime atmosphere, an optically
shallow estuary of either clear or turbid water, and one of three
possible bottom types: vegetation, sand, or mud.  Upwelling radiance
was calculated for each case in TM bands 1, 2 and 3 and MSS bands 4
and 5 using data available in the literature.  A spectral quality
index was defined similar to the equation for apparent contrast and
was used to evaluate the relative effectiveness of TM and MSS bands
in detecting submerged vegetation.

3. Significant Results

    Computer analysis of the Vaucluse Shores TM image resulted in
a bottom feature classification that correlates well with the
findings of Wetzel (1982).  One must keep in mind, however, that
at least 18 months separate Wetzel's measurements and the TM image.

Disagreements within the classification are most often associated geographically with a large offshore sand bar. The classification agrees best with areas reported by Wetzel to be inhabited by _Zostera_. Most of the areas indicated by Wetzel to be inhabited by _Ruppia_ were classified as sand. This is intuitively correct because by mid-November most of the _Ruppia_ dies back exposing the underlying sand.

If one considers only the spectral aspect of the problem, the effectiveness of a sensor to discriminate between submerged features is determined by the inherent contrast between the features and the absorbing and scattering properties of the water column and atmosphere. In optically shallow water, holding the atmosphere constant, the inherent contrast between submerged features appeared to be the most influential factor. As the optical depth of the water increased, the optimum sensor band for detecting a submerged feature shifted towards those for which the water was most transparent.

Perhaps the most significant result of this research thus far is the extent to which it has highlighted the need for optical data of high spectral resolution. We have become concerned about the variation in optical characteristics of natural waters and bottom features across sensor bands. This research has shown, for example, that under certain conditions the apparent contrast between two submerged features may decrease to zero at some intermediate depth and then increase for yet deeper depths. Without detailed knowledge of the variation in optical properties across sensor bands, this could not have been predicted.

4.  Publications

1)  Ackleson, S.G. and V. Klemas. "Assessing Landsat TM and MSS Data for Detecting Submerged Plant Communities", LANDSAT-4 Early Results Symposium, NASA Goddard Space Flight Center, February 23-24, 1983.

2)  Hardisky, M.A. and V. Klemas. "Remote Sensing of Coastal Wetlands Biomass Using Thematic Mapper Wavebands", LANDSAT-4 Early Results Symposium, NASA Goddard Space Flight Center, February 23-24, 1983.

5.  Recommendations

If no TM data is available for any given test site, investigators should be encouraged to request TM data for other yet similar sites, until more data becomes available for the prime site. This procedure has helped us save much time as far as learning to analyze TM data and getting good preliminary results.

## 7. Data Utility

A project is being developed with State agencies to use Landsat 4 TM to study the environmental degradation of Delaware's inland bays (Rehoboth Bay, Indian River Bay, etc.) These bays are shallow, their shorelines are overdeveloped (e.g. summer homes, marinas, etc.) and as a result the pollution concentrations are reaching dangerous levels. The State is proposing to analyze TM data on our ERDAS system to study turbidity plumes and circulation patterns in the bays and map changes in vegetation around the bays.

We have found that all major wetland vegetation species can be clearly discerned in TM imagery. The spatial resolution of TM data appears to be better than 30 meters, i.e. it seems to be closer to 25 meters than 30 meters.

A significant amount of the submerged grass beds in the Choptank River/Chesapeake Bay are large enough to be resolved in TM data. In many cases, the number of pixels represented is on the order of 10. If it is possible to differentiate between submerged vegetation and other submerged features as well as water features, TM data would become quite valuable for inventorying submerged plants. At the present time, this is done by aircraft and aerial photography and in many cases is prohibitively expensive.